CLAIMS

1. An apparatus for forming a fiber from a biocompatible biopolymer, the apparatus comprising:

a fiber-formation tube defining a tube axis and extending generally vertically from an upper end to a lower end, the fiber-formation tube having an inner wall defining a bore,

a fluid inlet coupled to the upper end of the fiber-formation tube for establishing a flow of coagulation fluid within a coagulation zone of the bore, the flow defining an upstream direction and a downstream direction along the tube axis,

a spinneret coupled to the bore at a point downstream from said fluid inlet and adapted to introduce the biopolymer into the coagulation zone, the biopolymer being surrounded by coagulation fluid so as not to contact the inner wall of the bore in the coagulation zone and being swept downstream by the flow, and

a fluid outlet disposed downstream from said spinneret at a distance selected to enable the biopolymer stream to coagulate, in the presence of the coagulation fluid, by said fluid outlet.

2. An apparatus for forming a fiber from a biocompatible biopolymer, the apparatus comprising:

a fiber-formation tube defining a tube axis and extending from a first end to a second end, the fiber-formation tube having an inner wall defining a bore,

a fluid inlet coupled to the first end of the fiber-formation tube to establish a laminar flow of coagulation fluid within a laminar zone of the bore, the laminar flow being generally parallel to the tube axis and defining an upstream direction and a downstream direction along the tube axis,

a spinneret coupled to the bore at a point downstream from said fluid inlet and adapted to introduce the biopolymer into the laminar zone, the biopolymer being surrounded by coagulation fluid so as not to contact the inner wall of the bore in the laminar zone and being swept downstream by the laminar flow, and

a fluid outlet disposed downstream from said spinneret at a distance selected to enable the biopolymer to coagulate, in the presence of the coagulation fluid, into a fiber upstream from or at said fluid outlet.

3. An apparatus for forming a biopolymer fiber from a stream of biocompatible biopolymer, the apparatus comprising:

a fiber-formation tube defining a tube axis and extending generally vertically from an upper end to a lower end, said fiber-formation tube having an inner wall defining a bore,

a fluid inlet coupled to the upper end of said fiber-formation tube for establishing a laminar flow of coagulation fluid within a laminar zone of the bore, the laminar flow being generally parallel to the tube axis and defining an upstream direction and a downstream direction along the tube axis,

a spinneret coupled to the bore at a point downstream from said fluid inlet and adapted to introduce the biopolymer stream into the laminar zone, the biopolymer stream being surrounded by coagulation fluid so as not to contact the inner wall of the bore in the laminar zone and being swept downstream by the laminar flow, and

a fluid outlet disposed downstream from said spinneret at a distance selected to enable the biopolymer stream to coagulate, in the presence of the coagulation fluid, into a fiber upstream from or at said fluid outlet.

4. The apparatus of claim 3 further comprising a dehydration-bath inlet disposed to introduce dehydration fluid into the bore downstream from said spinneret.

5. The apparatus of claim 3 further comprising a fluid diverter coupled to said fluid outlet for separating coagulation fluid from the collagen fiber at said fluid outlet.

6. The apparatus of claim 3 wherein said spinneret is disposed at the laminar zone.

7. The apparatus of claim 3 wherein said spinneret is coaxial with the tube axis.

8. The apparatus of claim 3 wherein said spinneret is disposed to introduce the biopolymer stream along an axis coaxial with the tube axis.

9. The apparatus of claim 3 wherein said spinneret comprises a tube.

10. The apparatus of claim 9 wherein said tube has a length between about 1 inch and about 3.5 inches.

11. The apparatus of claim **9** wherein said tube has an inner diameter between about 0.003 inches and about 0.030 inches.

12. The apparatus of claim **9** further comprising an anchoring element extending between an outer wall of said tube and the inner wall of the fiber-formation tube, the anchoring element adapted to suspend said tube in the bore of said fiber-formation tube.

13. The apparatus of claim **9** wherein said tube comprises a curved section adapted to engage the inner wall of the fiber-formation tube and to thereby fixedly secure tube within the bore of said fiber-formation tube.

14. The apparatus of claim **3** wherein said fiber-formation tube has a length between about 3 inches and about 240 inches.

15. The apparatus of claim **14** wherein said fiber-formation tube has an inner diameter between about 0.01 inches and about 0.10 inches.

16. The apparatus of claim **15** wherein said fiber-formation tube has an inner diameter of about 0.032 inches.

17. The apparatus of claim **3** wherein the biocompatible biopolymer comprises a liquid collagen solution.

18. The apparatus of claim **17** wherein the liquid collagen solution comprises a collagen solution having a concentration between about 1mg/ml and about 60 mg/ml.

19. The apparatus of claim **3** wherein the coagulation fluid comprises a solution of a buffering agent.

20. The apparatus of claim **19** wherein said buffering agent includes triethanolamine.

21. The apparatus of claim **19** wherein the triethanolamine concentration is between about 10mM and 200mM.

22. The apparatus of claim **19** wherein the coagulation fluid is a solution of HEPES having a concentration of about 100mM.

23. The apparatus of claim **19** wherein the coagulation fluid is selected to have a pH range between neutral and basic.

24. The apparatus of claim **23** wherein the coagulation fluid is selected to have a pH of approximately 7.5.

25. The apparatus of claim **3** further comprising temperature control means for maintaining the biocompatible biopolymer at a temperature of approximately 4°C.

26. The apparatus of claim **3** further comprising temperature control means for maintaining the coagulation fluid at a temperature of between about 4°C and about 37°C.

27. The apparatus of claim **3** further comprising a propulsion fluid inlet coupled to said fiber-formation tube downstream from said spinneret, for providing a flow of propulsion fluid to propel the biopolymer stream to said fluid outlet.

28. A method for forming a fiber from a biocompatible biopolymer, the method comprising the steps of

creating a vertically-directed flow of coagulation fluid having an upstream direction and a downstream direction,

injecting, into the downstream direction of the vertically-directed flow of coagulation fluid, a stream of biocompatible biopolymer selected to coagulate in response to contact with the coagulation fluid, the stream being injected so as to be surrounded by coagulation fluid and propelled in the downstream direction by the vertically-directed flow of coagulation fluid, and

allowing the coagulation fluid to coagulate the biopolymer stream, thereby forming a biopolymer fiber.

29. The method of claim **28** further comprising the step of separating the biopolymer fiber from the coagulation fluid.

30. A method for forming a fiber from a biocompatible biopolymer, the method comprising the steps of

creating a laminar flow of coagulation fluid having an upstream direction and a downstream direction,

injecting, into the downstream direction of the laminar flow of coagulation fluid, a stream of biocompatible biopolymer selected to coagulate in response to contact with the coagulation fluid, the stream being injected so as to be surrounded by coagulation fluid and propelled in the downstream direction by the laminar flow of coagulation fluid, and

allowing the coagulation fluid to coagulate the biopolymer stream, thereby forming a biopolymer fiber.

31. The method of claim **30** further comprising the step of separating the biopolymer from the coagulation fluid.

32. The method of claim **30** further comprising the step of passing the biopolymer fiber through a dehydration fluid.

33. The method of claim **30** wherein the step of separating the biopolymer fiber from the coagulation fluid comprises the step of providing a fluid diverter.

34. The method of claim **30** further comprising the step of selecting the biocompatible biopolymer to be a liquid collagen solution.

35. The method of claim **34** wherein the step of selecting liquid collagen solution comprises the step of selecting a collagen solution having a concentration between about 1mg/ml and about 60 mg/ml.

36. The method of claim **30** further comprising the step of selecting said coagulation fluid to be a solution of a buffering agent.

37. The method of claim **30** further comprising the step of selecting the coagulation fluid to be a solution of triethanolamine.

38. The method of claim **37** wherein the step of selecting the coagulation fluid further comprises the step of selecting the triethanolamine concentration to be between about 10mM and about 200mM.

39. The method of claim **30** further comprising the step of selecting the coagulation fluid to be a solution of HEPES having a concentration of about 100mM.

40. The method of claim **30** further comprising the step of maintaining the biocompatible biopolymer at a temperature of approximately 4°C.

41. The method of claim **30** further comprising the step of maintaining the coagulation fluid at a temperature of between about 4°C and about 37°C.

42 The method of claim **30** further comprising the step of providing a flow of propulsion fluid to propel the biopolymer stream in the downstream direction.